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BÜTSCHLI'S "PROTOZOA"

Bronn's Classen und Ordnungen des Thierreichs. New Issue. (Leipzig: C. F. Winter, 1883-4-5.)

THE important work on the lowest division of the animal kingdom which Prof. Bütschli, of Heidelberg, has undertaken for the publishers of the well-known series of zoological treatises originated by the late Prof. Bronn, is so far advanced as to enable us to form some estimate of its merits and to call for an extended notice. The separate parts of Prof. Bütschli's work which have appeared at intervals during the last two years have now accumulated so as to form a large octavo of 900 pages and 50 plates. The whole of the Protozoa have been discussed with the exception of the Ciliata, the Dino-flagellata (formerly called Cilio-flagellata), and the Acinetaria. The work does not comprise in its scope the Mycetozoa, which should, in the opinion of the present writer, be included in the animal kingdom. This is the less to be regretted, since an excellent work on this group has been recently published by Dr. Zopf, of Berlin, in the "Encyklopädie der Naturwissenschaften," and may be obtained separately of the publishers, Trewendt, of Breslau.

That the Mycetozoa are to be considered as animals rather than as plants is the opinion of no less an authority than the botanist De Bary, who has done more than any other observer to elucidate their life-history and structure.

Bütschli divides the Protozoa into classes as follows—the Sarkodina, the Sporozoa, the Mastigophora, and presumably the Ciliata and the Tentaculifera, though of the last two he has not yet written.

The Sarkodina are divided into the sub-classes Rhizopoda, Heliozoa, and Radiolaria.

The class Sporozoa contains the sub-classes Gregarinida, Coccidia, Myxosporidia, and Sarcosporidia.

The Mastigophora are grouped in sub-classes as Flagellata, Choanoflagellata, Cystoflagellata, and Cilioflagellata (now altered to Dinoflagellata).

Each of the sub-classes is treated of in turn in the thoroughly systematic and comprehensive manner which the readers of Bronn's "Thierreich" know so well and have so long appreciated. The treatment commences with a "Historical Review of the Development of our Knowledge of the Sub-class," which is no formal repetition of familiar commonplaces, but a really critical statement of the share contributed by various earlier naturalists to the building up of our present conceptions on the subject. This is followed by a wonderfully complete list of memoirs and papers relating to the group—under the heading "Literature." We have in many instances tested the completeness of these lists, and have found that even short papers in obscure periodicals which happen to contain facts of real importance have been duly hunted up and recorded by Prof. Bütschli.

Then follows a "Short Survey of the Morphological Characteristics of the Sub-class and its Chief Divisions," and after this each prominent morphological factor is taken separately and its variations in the group very

thoroughly discussed, references being given to the widely scattered writings of the numerous microscopists who have advanced this or that view or added this or that quantum of fact to our knowledge. Thus in the portion of the work relating to the Rhizopoda we find—

(1) The shell-structure of the Rhizopoda. A. Material of the shell—(a) chitinous shells; (b) calcareous shells; (c) shells built up of foreign particles; (d) siliceous shells. B. The morphological structure of the Rhizopod shell—(a) homaxonic shells; (b) monaxonic shells; (c) polythalamous shells; (d) abnormal shell-formation.

(2) The structure of the soft body of the Rhizopoda—(a) general characters of the soft body; (b) properties of the protoplasm of the Rhizopod-body in general; (c) differentiation of the protoplasm into special zones or regions; (d) coloration of the protoplasm; (e) peculiar bodies enclosed by the protoplasm, namely, non-contractile vacuoles, gas-bubbles, and peculiar products of metabolism, contractile vacuoles, nuclei; (f) pseudopodia, movement and inception of nutriment in the Rhizopoda; (g) gelatinous investment of the soft body.

(3) Relation of the soft body to the shell and formation of the shell by the soft body.

(4) Reproductive phenomena, colony-formation, and encystment of the Rhizopoda—(a) reproduction by simple division or budding; (b) colony-formation in connection with the division or budding of the Rhizopoda; (c) encystment in connection with or without reproduction; (d) copulation and conjugation in the Rhizopoda; (e) review of the attempts made to prove the existence of a sexual reproduction in the Rhizopoda.

(5) Biological relations of the Rhizopoda—(a) habitat; (b) nutrition; (c) dependance on external life-conditions.

(6) Taxonomy of the Rhizopoda—(a) historical development; (b) review of the system of the Rhizopoda, with brief characterisation of the divisions, inclusive of genera.

(8) Geographical distribution of the Rhizopoda.

(9) Palæontological development of the Rhizopoda.

This exhaustive discussion of the Rhizopoda occupies about 250 pages and 13 plates, in which the most important forms are figured: the figures being selected from all sources, and showing not only shell-structure but all that is known with regard to the protoplasmic body.

In the same thorough manner the subsequent groups of Sarkodina, of Sporozoa and Mastigophora are dealt with.

One point, however, to which we have not yet alluded gives Prof. Bütschli's work an altogether exceptional value. From what we have hitherto said it might appear that the work is simply a well-digested and critical survey of other men's work. This is not the case; the discussion of each group possesses a special value and importance from the fact that Prof. Bütschli has made very extensive researches himself in regard to the Protozoa, and has especially given attention to doubtful points, so that he is able to speak with the authority of a specialist in nearly every case. Portions of these researches, for instance those on the Radiolaria, on the Gregarinida and Myxosporidia (Psorosperms), and on the Flagellata have been already published from time to time during the past five years by Prof. Bütschli in various scientific journals. They have everywhere excited the greatest interest and have been recognised as most important additions to knowledge. In the present work they appear in due

place and enable Prof. Bütschli to give a decisive opinion upon many points on which authorities have hitherto differed. Many of the illustrations in the admirably engraved plates are also original.

We may perhaps remind our readers that it is to Prof. Bütschli that we owe the first important paper in the recent development of our knowledge of the karyokinetic figures of dividing cell-nuclei. It is his investigation which demonstrated the identity of the changes in the nuclei of Ciliate Infusoria with the curious fibrillation of normal tissue-cells when in course of division, and more than any others have given a wide basis to the recent generalisations on this subject.

Our author is not only extremely fair and scrupulous in citing all discoverable authorities for the facts which he sets forth as to the structure, &c., of Protozoa (our English microscopists of all ranks will find themselves cited and fairly considered), but he exhibits admirable judgment, temper, and caution in his treatment of vexed questions. He has wisely withheld his full discussion of the classification of the Radiolaria until such time as Haeckel's *Challenger* work on the group is published. In the meantime his analysis of the various forms of skeleton which occur in that group is a masterly essay on a very difficult subject.

With regard to the question of the chlorophyll corpuscles of some Protozoa—considered by Brandt as parasitic Algæ—we gather that Prof. Bütschli leans to the acceptance of that view; but we shall look for a more definite judgment from him in relation to that question when he has to discuss such forms as the Ciliata, *Stentor*, *Bursaria*, and *Ophrydium*.

It is noteworthy that Prof. Bütschli includes the Volvocina and the "Protococcus" forms in the Flagellata, being convinced of their relationship here in spite of their "holophytic" nutrition.

It would be impossible here to point out the numerous new views of importance which are advanced in Prof. Bütschli's work. It must be sufficient to say that the book is absolutely invaluable to every student of microscopic life, and is perhaps the most remarkable attempt yet made by a distinguished original observer to co-ordinate and render available for use the entire series of works of his predecessors in a large and important field of study.

E. R. LANKESTER

PHÆNOLOGY

Resultate der wichtigsten pflanzen-phänologischen Beobachtungen in Europa, nebst einer Frühlingskarte. Von Dr. H. Hoffmann, Professor der Botanik in Giessen. Anhang, Dr. Egon Ihne, *Die Norwegischen, Schwedischen, und Finnländischen Beobachtungen.* (Giessen: J. Ricker'sche Buchhandlung, 1885.)

THIS work, the results of forty years' labour, forms a most important contribution to the literature on the subject of phænology.

The work begins with an introduction, in which is explained the importance of phænological observations, particularly with regard to comparative climatology and biology. Then follows an investigation of the degree of accuracy to be obtained by this kind of observation, succeeded by a discussion as to how many years such

observations ought to be continued for obtaining useful and trustworthy information for comparative investigation. A table is then given of those plants and their phases which the author, after forty years' observations, thinks the most proper for adoption with a view to international reception. The number is fifty-three, and they are arranged according to the calendar, to facilitate observation; which system appears with regard to accuracy preferable to an alphabetical arrangement.

A short notice follows of the most important general results of the work with respect to climatology and biology, abstracted from the observations from the whole of Europe. At the end of the introduction the author points out the next tasks for phænological researchers.

The remainder of the book contains an alphabetical list of all phænological stations throughout Europe (about 2000), with the geographical situation and elevation above sea-level. Under each station are given in an alphabetical arrangement the mean dates of the simple phases known from the place, with the number of years of observation.

It is to be seen that from a great number of these but one or two years' observations have been published, whereas others extend to above thirty years. These dates are to be employed for comparing any single place with all the others. The mean dates are given as completely as possible, because such comparisons are the chief object of the author for publishing this work. They are extracted and calculated from a vast number of lists published in a great many periodicals and works of all nations.

With regard to spring flowers, the author himself has followed the plan of comparisons, giving under each station an indication of the number of days the single species open their flowers, sooner or later than at Giessen, the residence of the author, from which place, generally speaking, the most comprehensive observations have been published. In a "spring map" of Europe at the end of the book the results of these investigations are entered, by which the mean progress of spring through different countries may be seen at a glance.

OUR BOOK SHELF

Louis Pasteur, his Life and Labours. By his Son-in-Law. Translated from the French by Lady Claud Hamilton. (London: Longmans, Green, & Co., 1885.)

THE name of M. Pasteur, owing to his many brilliant and eminently practical discoveries, has been for some years so prominently before the general public that a popular and connected account of his life and labours cannot fail to be interesting and instructive reading to every educated member of the community. In this respect the present volume must be considered a signal success and a valuable addition to popular scientific literature. But the importance of the book reaches a step further, for it gives to the scientific world an authentic account of the development and progress of M. Pasteur's discoveries, since it is written by one who has been and is still living with M. Pasteur in the bonds of intimate friendship, and who has received his information directly from M. Pasteur himself. While to the general reader the achievement of a discovery is the only and great point of interest, to the scientific reader it is only one of many, the history of a discovery being one of them, and not the least important one, for it reveals methods and manner, and it gives us a true insight into the working of the